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Bedside Diagnosis of Urinary Infection

A Pilot Study

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Early recognition of catheter-associated urinary infection is essential to proper management. Daily bacteriological monitoring of indwelling catheters by routine urine culture is expensive and time consuming. A pilot study using liquid media at room temperature incubation showed a sensitivity approximating 90 percent in detecting bacteriuria. A simplified screening test can be carried out daily at the bedside; a positive screen would be followed by standard bacteriological studies. Such a method permits earlier diagnosis, and results in great saving in cost as well.

IN RECENT YEARS the incidence of urinary infection associated with indwelling catheters has been greatly reduced by aseptic catheterization, by emphasis on catheter care and by closed urinary drainage. Nevertheless, there is still significant morbidity and mortality from such infections. Therefore, it is important that catheter-associated urinary infection be recognized promptly so that appropriate treatment can be begun.

Kunin has recommended daily bacteriological monitoring of indwelling catheters.[1] Although this is the standard against which all other methods must be measured, daily urine culture suffers from several disadvantages:

- It is costly; at this writing, a negative urine culture costs a hospital patient in Los Angeles approximately $20; if the culture is positive, identification and sensitivity studies may bring the cost up to $40 or more.
- It is expensive in terms of personnel involved; after the physician orders the culture, the order is read by the nurse, then a designated person obtains the specimen by needle aspiration, transfers it to a suitable container and prepares an identifying label. Next someone transports the specimen to the laboratory where a bacteriologist inoculates, labels and incubates appropriate media. These are read at 24 and 48 hours, then a written report is prepared which then must be returned to the nursing floor and placed on the patient's chart. Only then are the results of the study available to the attending physician.
- Although most urinary pathogens show very evident growth within 16 to 18 hours, the report virtually never reaches the chart before 48 hours, and occasionally 72 hours may elapse before the written record is on the chart at the time the attending physician customarily makes rounds.

If a suitable screening test could be done at the patient's bedside, costs could be reduced and, even more important, recognition and treatment of urinary infection could take place a day or two earlier.

A number of chemical tests have been devised to detect infection. Those most commonly used in screening for urinary tract infection include the tetrazolium reduction test, the nitrate reduction to nitrite or Griess test, the glucose consumption test and the catalase test. Each of these methods

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has a number of disadvantages in terms of false positives or false negatives which render it unsuitable for use in the detection of catheter-associated infection.[2,3]

Certain simplified bacteriological methods have been used in screening for urinary infection; most of these involve one or more bacteriological media in some format designed to simplify inoculation and reading; the best known of these is the dipslide. These tests have high reliability when compared with routine bacteriological testing, are capable of giving a quantitative answer, and in some cases indicate whether Gram positive or negative organisms are present. They have been used extensively and found reliable and effective with room temperature incubation.[4-6]

Other simplified bacteriological procedures can be used. Liquid media can serve as sensitive indicators of bacterial growth. Virtually all urinary tract pathogens ferment glucose and acidify the medium sufficiently to produce gross color changes if indicators are incorporated. Although pseudomonas does not ferment glucose, it does acidify the medium in the presence of air. All of these organisms grow readily at room temperature.

A pilot study was set up to test this method in two local hospitals. The medium used throughout was dextrose broth. In 41 instances purple broth with dextrose containing brom cresol purple, 15 mg per liter, as indicator, adjusted to a pH of 6.8 was used. This medium is purple initially, becomes yellow when acidified. For the remainder phenol red dextrose broth containing phenol red, 18 mg per liter, as indicator adjusted to a pH of 7.4 was used; this medium is red initially and turns yellow when acidified. The color change from purple to yellow was a bit easier to read than that from red to yellow; no other significant difference in the two media was noted.

All urine specimens sent to the laboratories for culture and sensitivity were cultured by the usual techniques (EMB agar and phenyl-ethyl agar using a 0.001 ml inoculum) and by the simple dextrose broth room temperature (DBRT) method. After inoculating the usual media the technician put two drops of the urine specimen in a tube of the special medium, numbered the tube and placed it in a rack at room temperature. The color of the medium was read and recorded twice daily. At the conclusion of the experiment the data obtained in this way were compared with the final bacteriological report. In all 164 consecutive specimens were tested. In 91 instances the laboratory reported no growth at 48 hours. The data on the positive cultures are displayed in Table 1.

TABLE 1.—*Organisms Found on Laboratory Cultures*

Organism Found on Culture	*Greater Than 100,000/ml*	*Less Than 100,000/ml*	*DBRT Positive by 12 Hours*	*DBRT Positive by 24 Hours*
Escherichia coli	29		26	28
		7	4	6
Enterococcus ..... (group D streptococcus)	6		6	6
		6	4	6
Proteus mirabilis	4		4	4
		2	1	2
Enterobacter	9		8	9
		1	0	1
Pseudomonas	1		0	0
		1	1	1
Staphylococcus ..... (coagulase negative)	1		1	1
		9	4	6
Candida albicans	3		1	3
		1	0	1
Alpha streptococcus .	3		1	2
		4	1	2
Gamma streptococcus (not group D)		4	3	3
Lactobacillus		1	0	0

DBRT = dextrose broth room temperature method.

Analysis

When the bacteriology laboratory reported over 100,000 organisms per ml, the DBRT test was positive at 24 hours 93 percent of the time; indeed it was positive at 12 hours over 80 percent of the time. Including all cases reported by the laboratory as showing bacteriuria, no matter how slight, 87 percent were positive by the DBRT test at 24 hours. In 13 cases the DBRT test was positive at 24 hours but the laboratory reported no growth at 48 hours. Possibly contamination may have occurred. However, it is likely that the larger inoculum (100 fold greater) and the use of a liquid nutrient renders the DBRT test more sensitive in detecting mild bacteriuria than the usual methods using solid media.

Discussion

Although the number of cases in this series is small the high correlation between the DBRT test and orthodox testing results suggests that this method may be valuable for the early detection of urinary infection related to indwelling catheters. Unlike the dipslide this method gives no indication of how many bacteria are present. However, in a patient with an indwelling catheter, all bacteria must be presumed to be of significance;

under the circumstances sensitivity becomes more important than the ability to give a quantitative answer. The mechanics of dipslide inoculation present some problems not present in the DBRT method. In addition, reading the dipslide requires more sophistication than recognizing the difference between yellow and purple. I selected dextrose broth because of its ready availability, ease of preparation and many years of use in the laboratory. However, modifications in the composition of the medium may increase its sensitivity, especially to the nonfermenting bacteria.

What I envision is a simplified method of bedside diagnosis of urinary tract infection incorporating these key features:

- Each patient with an indwelling catheter would have daily bacteriological "screening."
- The specimen would be obtained aseptically through the puncture port which is now an integral part of most closed drainage systems.
- This specimen would best be obtained in a device which incorporates aspiration and storage within itself so as to avoid having to transfer it to another container. Such a device (Pharmaseal Urine Sampling Unit) is now being manufactured by one company.
- Preferably this container would incorporate within itself a bacteriological indicator like the DBRT medium or a variant of the dipslide.
- The container would then be attached to the patient's drainage bag, thereby serving to identify it without having to label it.
- Each morning the previous day's specimen would be read at the bedside by inspection. If negative, it would be discarded and a new container inoculated.
- If positive, an orthodox urine culture would be inoculated and treatment could be begun while awaiting the definitive sensitivity studies. Perhaps a Gram stain done on the positive bacteriological screening test might serve as a valuable guide to such treatment.

The results of this pilot study suggest that such a regimen of bedside testing using the DBRT medium would probably detect bacteriuria within 24 hours of its appearance 90 percent of the time. If such a method were in use today the morbidity and cost of such infection should be greatly reduced.

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